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भारतीय मानक

प्लास्टिक — परीक्षण पद्धतियाँ

भाग 8 स्थायी/रासायनिक गुण धर्म

अनुभाग 3 जल सहित द्रव रासायनिकों का प्रभाव ज्ञात करना

Indian Standard

PLASTICS — METHODS OF TESTING

PART 8 PERMANENCE/CHEMICAL PROPERTIES

Section 3 Determination of the Effects of Liquid Chemicals, Including Water

ICS 83.080

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

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Price Group 6

Methods of Test for Plastics Sectional Committee, PCD 23

NATIONAL FOREWORD

This Indian Standard which is identical with ISO 175 : 1981 'Plastics — Determination of the effects of liquid chemicals, including water', issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Methods of Test for Plastics Sectional Committee and approval of the Petroleum, Coal and Related Products Division Council.

The text of ISO Standard has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 62 : 1980 Plastics — Determination of water absorption	IS 13360 (Part 8/Sec 1) : 1997 Plastics — Methods of testing : Part 8 Permanence/ chemical properties, Section 1 Determination of water absorption	Identical
ISO 291 : 1977 Plastics — Standard atmospheres for conditioning and testing	IS 196 : 1966 Atmospheric conditions for testing (*revised*)	Technically Equivalent
ISO 293 : 1986 Plastics —Compression moulding test specimens of thermoplastic materials	IS 13360 (Part 2/Sec 1) : 1992 Plastics — Methods of test : Part 2 Sampling and preparation of test specimens, Section 1 Compression moulding test specimens of thermoplastic materials	do
ISO 294 : 1995 Plastics — Injection moulding of test specimens of thermoplastics material	IS 8543 (Part III/Sec 2) : 1978 Methods of testing plastics : Part III Preparation of test specimens, Section 2 Injection moulded test specimens	Not technically equivalent in all respects. However, this Indian Standard will be considered for revision to align it with ISO standard as and when the revised version of ISO 294 : 1995 is available
ISO 295 : 1991 Plastics —Compression moulding test specimens of thermosetting materials	IS 13360 (Part 2/Sec 2) : 1995 Plastics — Methods of testing : Part 2 Sampling and preparation of test specimens, Section 2 Compression moulding of test specimens of thermosetting materials	Identical
ISO 412 : 1976 Gum spirit of turpentine and wood turpentines for paints and varnishes (Withdrawn in 1994)	—	—

(*Continued on third cover*)

Indian Standard

PLASTICS — METHODS OF TESTING

PART 8 PERMANENCE/CHEMICAL PROPERTIES

Section 3 Determination of the Effects of Liquid Chemicals, Including Water

0 Introduction

Because of their varied applications, plastics are frequently brought into contact with liquids such as chemical products, motor fuels, lubricants, etc., and, possibly, with their vapours.

Under the action of a liquid, a plastic material may be subjected to several phenomena which may occur simultaneously. On the one hand absorption of liquid and extraction of constituents soluble in the liquid may occur. On the other hand, a chemical reaction, most often resulting in a significant change in the properties of the plastic, may occur.

The behaviour of plastics in the presence of chemicals can be determined only under arbitrarily fixed conditions aimed at making comparisons between different materials. The choice of test conditions (nature of the liquids, temperatures and durations), as well as of the properties in which changes are to be measured, depends on the eventual application of the plastic under test.

However, it is not possible to establish any direct correlation between the experimental results and the behaviour of the plastic in service. These tests do, nevertheless, permit a comparison to be made of the behaviour of different plastic materials under specified conditions, thus allowing an initial evaluation of their behaviour in relation to certain groups of substances.

NOTE — In view of its special importance, the particular case of the determination of the quantity of water absorbed is dealt with in ISO 62. The effects of water described in this International Standard are concerned only with changes in dimensions and in physical properties as a result of the action of the water.

1 Scope and field of application

1.1 This International Standard specifies a method of exposing test specimens of plastic materials, free from all external restraint, to liquid chemicals, and methods for determining the changes in properties resulting from such exposure.

1.2 It only considers, therefore, testing by immersion of the entire surface of the test specimen.[1]

1.3 It is applicable to all solid plastics that are available in the form of moulding or extrusion materials, plates, tubes, rods or sheets, having a thickness greater than 0,1 mm. It is not applicable to cellular materials.

1.4 Methods for determination of changes in properties are specified as follows :

a) changes in mass, dimensions and appearance immediately after immersion or after immersion and drying;

b) changes in physical properties (mechanical, thermal, optical, etc.) immediately after immersion or after immersion and drying.

1.4.1 The test immediately after immersion is used when it is required to ascertain the state of the material while still acted upon by the liquid.

1.4.2 The test after immersion and drying is used when it is required to ascertain the state of the material after the liquid, if it is volatile, has been eliminated. It can allow determination of the influence of a soluble constituent.

2 References

ISO 62, *Plastics — Determination of water absorption.*

ISO 291, *Plastics — Standard atmospheres for conditioning and testing.*

ISO 293, *Plastics — Compression moulding test specimens of thermoplastic materials.*

ISO 294, *Plastics — Injection moulding test specimens of thermoplastic materials.*

ISO 295, *Plastics — Compression moulding test specimens of thermosetting materials.*

ISO 412, *Gum spirit of turpentine and wood turpentines for paints and varnishes.*

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[1] Although it is not within the scope of this International Standard, it may also be of interest, when dealing with volatile liquids or those which give off vapours, to submit the specimen to the effect of only the gaseous phase above the liquid. In this event, it is advisable to proceed exactly as indicated, but to suspend the test specimen above the liquid, seal the container and maintain it at the test temperature throughout.

ISO 1817, *Vulcanized rubbers — Resistance to liquids — Methods of test.*

ISO 2818, *Plastics — Preparation of test specimens by machining.*

ISO 3126, *Plastics pipes — Measurement of dimensions.*

ISO 3205, *Preferred test temperatures.*

IEC Publication 296, *Specification for new insulating oils for transformers and switchgear.*

3 Principle

Complete immersion of test specimens in a test liquid for a specified time and at a specified temperature.

Determination of their properties before and after immersion and, if applicable, after drying; in the latter case, the determinations are made, if possible, one after the other on the same specimens.

NOTE — It is emphasized that the comparison of different plastics by means of this test is valid only if the specimens used are of the same shape, the same dimensions (in particular the same thickness) and in as nearly as possible the same state (of internal stresses, surface, etc.).

4 General requirements and procedure

4.1 Test liquids

4.1.1 Choice of test liquid

If information is required about the behaviour of a plastic in contact with a specific liquid, that liquid shall, as a rule, be used.

Industrial liquids are not generally of absolutely constant composition. Whenever possible, the test shall be carried out in defined chemical products used on their own or as a mixture, and which are as representative as possible of the effect of the products under consideration on the plastic material concerned.

NOTE — If making a series of tests in a liquid of doubtful composition, it is important to take all the samples of the liquid from the same container.

4.1.2 Test liquids

Types of test liquids are given in annex A.

4.2 Test temperatures

4.2.1 Immersion temperatures

The preferred test temperatures are :

a) 23 ± 2 °C;

b) 70 ± 2 °C.

If a different temperature has to be used in order to correspond to the temperature at which the plastic is used, it shall be selected from the preferred temperatures given in ISO 3205.[1)]

NOTE — In the event that the test is to be carried out at a temperature above normal ambient conditions, it may be desirable to condition another series of specimens at this temperature for a period equal to that of the test, and to measure their properties after this conditioning in order to be able to distinguish the effect of temperature from that of the liquid.

In the case of long duration tests, specimens stored in air at 23 °C may undergo a change in properties. Preparation of an additional series of test specimens is recommended for comparison purposes.

4.2.2 Measurement temperature

The temperature for the determination of changes in mass, dimensions or physical properties is 23 ± 2 °C. If the immersion temperature is different, bring the specimen to 23 °C by the procedure described in 4.6.3.

4.3 Test durations

The preferred test durations are :

a) 24 h for a short duration test;

b) 1 week for a standard test (particularly at 23 °C);

c) 16 weeks for a long duration test.

If it is essential to adopt other test durations, for example if it is desired to perform tests as a function of time or to plot the curve until equilibrium is reached, it is recommended that the durations be chosen from the following standard scale :

a) 1 — 2 — 4 — 8 — 16 — 24 — 48 — 96 — 168 h;

b) 2 — 4 — 8 — 16 — 26 — 52 — 78 weeks;

c) 1,5 — 2 — 3 — 4 — 5 years.

---

1) In particular, the following temperatures should be used :

0 — 20 — 27 — 40 — 55 — 85 — 100 — 125 — 150 °C,

with a tolerance of ± 2 °C on temperatures up to and including 105 °C, and ± 3 °C on temperatures greater than 105 °C and up to and including 200 °C.

In the special case of testing plastic pipes, the temperature of 60 °C given in the annex to ISO 3205 may be used.

4.4 Test specimens

Depending upon the proposed test after exposure (mass, dimensions, physical properties) and the nature and form (sheet, film, rod, etc.) of the plastic material, the specimens will be of very diverse shapes and dimensions.

They may be obtained directly by moulding, or by machining. In the latter case, cut surfaces shall be machined to a fine finish and shall show no trace of carbonization that could be attributed to the method of preparation.

The number of specimens to be used will be specified in the International Standards relevant to the tests to be carried out after treatment. In the absence of specific International Standards, at least three specimens shall be tested.

4.5 Conditioning

Condition the specimens in accordance with ISO 291.

NOTE — For certain plastics which are known to approach rapidly, or, on the contrary, very slowly, equilibrium of temperature and especially of humidity, shorter or longer conditioning periods may be specified in the appropriate product specifications (see annex B).

4.6 Procedure

4.6.1 Quantity of test liquid

The quantity of test liquid used shall be at least 8 ml per square centimetre of the total surface area of the specimen in order to avoid a concentration of extracted product in the liquid during the course of the test. The test liquid shall cover the specimen completely.

NOTE — A different quantity of liquid may, however, be specified in particular International Standards; for example, for rigid PVC and polyolefin pipes, where the amount of extractable substances is known to be very small, a smaller quantity of liquid is specified in the relevant International Standards.

4.6.2 Positioning of specimens

As a rule, place each set of test specimens in a given container and completely immerse them in the test liquid (using a weight if necessary).

However, when several materials of the same composition are to be tested, it is permissible to put several sets of specimens into the same container.

In every case, no significant proportion of the surfaces of the specimens shall make contact with the surface of other specimens, with the walls of the container, or with any weight that is used.

During the test, stir the liquids, for example by rotating the containers, at least once per day.

If the test lasts longer than seven days, replace the liquid with an equal amount of the original liquid every seventh day.

If the liquid is unstable (for example sodium hypochlorite), replace the liquid more frequently.

If light is likely to have an influence on the action of the test liquid, it is recommended to operate either in darkness or in defined illumination conditions.

It may be necessary in certain cases (for example if there is a risk of oxidation) to specify the height of the liquid level above the specimens.

4.6.3 Rinsing and wiping

At the end of the period of immersion, bring the temperature of the specimens back to ambient temperature if necessary, by transferring them quickly into a fresh quantity of test liquid at room temperature, for a period of 15 to 30 min.

Remove the specimens from the test liquid and rinse them with a product which has no effect on the material under test and which is chosen to suit the nature of the test liquid.

Wipe the specimens dry with filter paper or a lint-free cloth.

NOTES

1 If requested, it may be necessary to examine the test liquid at the end of the test. This examination may be a simple visual examination or a more rigorous examination, including, for example, a titration.

This examination may not be practicable if the liquid has been replaced during the test.

2 In the case of specimens tested in solvents such as acetone or alcohol at ambient temperature, rinsing and wiping may not be necessary.

4.7 Expression of results

4.7.1 Numerical expression

In addition to the results of measurements before and after immersion, the results may be expressed (except in special cases of changes in mass) as a percentage of the value of the property after immersion (V_2) with respect to the value before immersion (V_1), i.e. as

$$(V_2/V_1) \times 100$$

4.7.2 Graphical expression

In every case where measurements are made as a function of time, it is recommended that corresponding graphs be plotted. The values obtained (including the original value), or the differences in value, shall be plotted as the ordinates, and the durations (t) as the abscissae. If it is necessary to shorten the duration scale, either a $\sqrt{t}$ scale or a log t scale may be used.

5 Determination of changes in mass and (or) dimensions and (or) appearance

These determinations may, if necessary, be carried out on the same specimens.

At least three specimens shall be used.

5.1 Apparatus

5.1.1 Beakers, of suitable dimensions and fitted with lids (airtight, if necessary, and fitted with condensers in the case of volatile liquids or those which give off vapours).

5.1.2 Enclosure, thermostatically controlled at the test temperature.

5.1.3 Thermometer, of suitable range and accuracy.

5.1.4 For determination of changes in mass :

5.1.4.1 Weighing bottle.

5.1.4.2 Balance, accurate to within 0,001 g in the case of specimens of mass equal to or greater than 1 g, or to within 0,000 1 g in the case of specimens of mass less than 1 g.

5.1.5 For determination of dimensional changes :

5.1.5.1 Dial micrometer, with flat anvils, accurate to 0,01 mm.

5.1.5.2 Caliper gauge, capable of measuring to an accuracy of 0,1 mm.

5.1.6 Ventilated oven, if required, capable of being controlled at the chosen drying temperature.

NOTE — In the absence of any special instructions, use an oven controlled at 50 ± 2 °C.

5.2 Test specimens (see also 4.4)

5.2.1 Moulding materials

Specimens shall have a diameter of 50 ± 1 mm and a thickness of 3 ± 0,2 mm. They shall be moulded to shape under the conditions specified in the appropriate product specification (or under the conditions prescribed by the supplier).

NOTES

1 The general principles for the preparation of moulded specimens are the subjects of ISO 293, ISO 294 and ISO 295.

2 In certain special cases, a square specimen, 50 mm × 50 mm × 4 mm, may be used by agreement between the interested parties.

5.2.2 Extrusion compounds

Specimens shall have a diameter of 50 ± 1 mm and a thickness of 3 ± 0,2 mm. They shall be cut from a sheet of this thickness, prepared under the conditions prescribed in the appropriate product specification (or under the conditions prescribed by the supplier of the material).

NOTE — In certain special cases, a square specimen, 50 mm × 50 mm × 4 mm, may be used by agreement between the interested parties.

5.2.3 Sheets and plates

Specimens shall be 50 ± 1 mm square and shall be machined from the sheet or plate submitted for test.[1]

The thickness of the specimens shall be the same as that of the sheet or plate submitted for test, if its nominal thickness is less than or equal to 25 mm.

If the nominal thickness is greater than 25 mm, and in the absence of special provisions in the relevant specification, reduce the thickness of the specimen to 25 mm by machining one face only.

5.2.4 Tubes and rods

5.2.4.1 Tubes

If possible, reference shall be made to the relevant International Standards for the material under test.[2] In the absence of specific International Standards, the specimen shall be a piece of tube, of length 50 ± 1 mm, obtained by cutting it at right angles to its longitudinal axis.

For tubes of outside diameter greater than 50 mm, a length of 50 ± 1 mm shall be cut and the test specimen prepared from this length by making a cut along each of two planes containing the longitudinal axis of the tube, so as to give a developed width of 50 ± 1 mm when measured on the outer surface.

5.2.4.2 Rods

For rods of diameter less than or equal to 50 mm, the test specimen shall be a piece of the rod of length 50 ± 1 mm, obtained by cutting it at right angles to its longitudinal axis.

For rods of diameter greater than 50 mm, in the absence of any specification agreed between the interested parties, the test specimen shall be a 50 ± 1 mm length of the rod with its diameter reduced to 50 ± 1 mm by machining concentrically.

5.2.5 Profile sections

In the absence of specific International Standards, cut a 50 ± 1 mm long piece of the profile section and use as the test specimen either :

a) this piece of the profile section;

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[1] For example, in accordance with ISO 2818.

[2] The preparation of methods of test for plastics pipes is the responsibility of ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*. The general procedures described in this International Standard have been used as a basis for the appropriate methods of evaluating the effects of chemical products on plastics pipes. ISO 4433 will specify the method of test for polyolefin pipes; methods of test for PVC and ABS pipes will form the subjects of future International Standards.

b) this piece after machining in such a manner as to reduce one or several of the dimensions of the profile cross section so that the thickness, in particular, approximates as closely as possible to 3 ± 0,2 mm.

In this case, the dimensions to be achieved and the machining conditions shall be subject to agreement between the interested parties.

5.3 Determination of changes in mass[1]

5.3.1 Procedure

5.3.1.1 Conditioning

Condition the specimens and select the test conditions in accordance with clause 4.

5.3.1.2 Determination of initial mass

Determine the mass m_1 of each specimen to the nearest 0,001 g in the case of specimens of mass greater than or equal to 1 g, or to the nearest 0,000 1 g in the case of specimens of mass less than 1 g.

Immerse the specimens in the test liquid as specified in 4.6.2.

5.3.1.3 Measurement immediately after immersion

Place each rinsed and wiped specimen in a tared weighing bottle, stopper it and determine the mass m_2 to the nearest 0,001 g or 0,000 1 g as appropriate (see 5.3.1.2).

If the liquid used for the test is volatile at ambient temperature, the time during which the specimen is exposed to the air shall not exceed 30 s. If it is necessary to continue the test after weighing (test as a function of time), immediately replace the specimens in the test liquid and put the containers back in the thermostatically controlled enclosure.

5.3.1.4 Measurement after immersion and drying

Remove the specimens from the weighing bottles and dry them in the oven at the specified temperature (usually for 2 h at 50 ± 2 °C) to constant mass. Cool the specimens if necessary, recondition them in accordance with 5.3.1.1 and determine the mass m_3 of each specimen.

NOTE — In certain cases, the interested parties may agree that the plastics under test require no conditioning.

5.3.1.5 Measurement only after immersion and drying

After removal from the test liquid, rinse and wipe the specimens in accordance with 4.6.3, then immediately place the specimens in the oven and proceed in accordance with 5.3.1.4.

5.3.2 Calculation and expression of results

5.3.2.1 Report, for each specimen, the masses in milligrams, of

a) the specimen before immersion, m_1;

b) the specimen immediately after immersion, m_2;

c) the specimen after immersion, drying and reconditioning, m_3.

Calculate the values of

$m_2 - m_1$,

and

$m_3 - m_1$,

and report these values with the applicable signs.

5.3.2.2 It is permissible, subject to agreement between the interested parties, or on request, to express the results by the following methods.

5.3.2.2.1 Method I — Change in mass per unit area

For each specimen, calculate the increase or decrease in mass per unit area, expressed in milligrams per square centimetre, by means of one of the following formulae

$(m_2 - m_1)/A$

or

$(m_3 - m_1)/A$

where

m_1, m_2 and m_3 have the same meanings as in 5.3.2.1;

A is the initial total surface area, in square centimetres, of the specimen.

5.3.2.2.2 Method II — Percentage change in mass

For each specimen, calculate the percentage increase or decrease in mass by means of one of the following formulae

$100\,(m_2 - m_1)/m_1$

or

$100\,(m_3 - m_1)/m_1$

where m_1, m_2 and m_3 have the same meanings as in 5.3.2.1

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[1] In the case of water, see ISO 62.

5.3.2.3 In every case, calculate the arithmetic mean (or means) of the results for specimens taken from the same sample.

5.4 Determination of changes in dimensions

5.4.1 Procedure

5.4.1.1 Conditioning

Condition the specimens and select the test conditions in accordance with clause 4.

5.4.1.2 Determination of initial dimensions of test specimens

5.4.1.2.1 Discs

Mark and measure two mutually perpendicular diameters to the nearest 0,1 mm by means of the caliper gauge. Record the mean, l_1.

Measure the thickness of the specimen at four reference points to the nearest 0,01 mm by means of the dial micrometer. Record the mean, e_1.

These points shall be situated at least 10 mm from the edges of the specimen.

5.4.1.2.2 Square specimens

Mark and measure the lengths of the four sides of the specimen to the nearest 0,1 mm by means of the caliper gauge. Record the mean, l_1.

Measure the thickness of the specimen at four reference points to the nearest 0,01 mm by means of the dial micrometer. Record the mean, e_1.

These points shall be situated at least 10 mm from the edges of the specimen.

5.4.1.2.3 Rods and profile sections

Measure and record the length (l_1) of the specimen to the nearest 0,1 mm by means of the caliper gauge.

Measure the thickness of the specimen at four reference points to the nearest 0,01 mm by means of the dial micrometer. Record the mean, e_1.

NOTE — If the thickness of the section is not constant, measure it in two regions of different thickness.

5.4.1.2.4 Tubes

Carry out the measurements (of d_1, l_1 and e_1) as specified in ISO 3126.

5.4.1.3 Immersion

Immerse the specimens as indicated in 4.6.2.

5.4.1.4 Measurement immediately after immersion

Make the same measurements on each specimen as in 5.4.1.2. Record the mean values of d_2, l_2 and e_2, as appropriate.

NOTE — As a general rule, it is recommended not to wait before commencing the determination of dimensions.

5.4.1.5 Measurement after immersion and drying

Dry the specimens in the oven at the temperature prescribed and for the specified time (usually for 2 h at 50 ± 2 °C). Allow the specimens to cool if necessary, recondition them in accordance with 5.4.1.1, then make the same measurements on each specimen as in 5.4.1.2. Record the mean values of d_3, l_3 and e_3, as appropriate.

NOTE — In certain cases, the interested parties may agree that the plastics under test require no conditioning.

5.4.1.6 Measurement only after immersion and drying

Immediately after immersion, remove the specimens, rinse and wipe them, then place the specimens in the oven and proceed as described in 5.4.1.5.

5.4.2 Calculation and expression of results

5.4.2.1 In addition to reporting the initial and final dimensions, express the final dimensions as percentages of the initial dimensions. Calculate these percentages for each specimen, each dimension, and each variation of test procedure. These percentages may be greater than, equal to, or less than 100 %, the value 100 % signifying that the action of the liquid has not changed the dimension.

5.4.2.2 Calculate the arithmetic mean (or means) of the results relating to the specimens taken from the same sample.

5.4.2.3 If applicable, plot graphs of the results as a function of test duration.

5.5 Determination of changes in appearance

Examination of changes in appearance may be conducted together with the other tests described in this International Standard, or may be carried out separately. In every case, prepare supplementary specimens for comparison.

5.5.1 Procedure

5.5.1.1 If the change in appearance is determined as a complement to one of the tests specified in this International Standard, use the procedure specified for that test.

5.5.1.2 If the change in appearance is determined separately, use the general procedure (see clause 4) subject to agreement between the interested parties.

5.5.1.3 Examine each specimen, by means of a lens if necessary, in comparison with an untreated specimen and ecord any changes in appearance as follows, using the notation scale given in table 1 :

a) colour (including the nature of the change and whether or not it is uniform);

b) opacity;

c) gloss or matt finish.

Note also, if present, the following effects :

a) development of crazing and cracking;

b) development of blisters, pitting and other similar effects;

c) presence of material which can be easily rubbed off;

d) tacky appearance;

e) delamination, warping or other deformation;

f) partial dissolution.

Table 1 — Notation scale

Notation	Change in appearance
O	none
F	slight
M	moderate
L	large

5.5.2 Expression of results

Express the results using the notation scale given in table 1.

Report separately the results relating to specimens that have been simply immersed and wiped dry and those relating to specimens that have also been oven-dried and reconditioned.

6 Determination of changes in physical properties

The properties investigated may be mechanical, electrical, thermal or optical, etc.

6.1 Apparatus

6.1.1 Apparatus specified in clause 5 excluding the balances unless required for special cases.

6.1.2 Apparatus specified in the appropriate International Standards for the determination of the properties under consideration.

6.2 Test specimens

6.2.1 Shape and dimensions

The specimens shall have the shape and dimensions specified in the relevant International Standards for the determination of the properties under consideration.

If several sizes of test specimen are allowed, choose, in preference, the size having a thickness nearest to 4 mm. (See the note to clause 3.)

6.2.2 Preparation

Follow the instructions of the relevant International Standard.

Certain properties are very sensitive to internal stresses in the samples; consequently, in order to evaluate end products, it is recommended that specimens taken from these products be used rather than specially moulded or extruded specimens.

6.2.3 Number

Prepare the number of specimens specified in the relevant International Standard. In the case of tests that alter the test specimen (in particular, tests to destruction) prepare additional specimens to serve as a control.

6.3 Procedure

6.3.1 Conditioning

Condition the specimens and choose the conditions of test in accordance with clause 4.

Determine the initial values of the selected physical properties in accordance with the relevant International Standards.

Immerse the specimens in the test liquid as indicated in 4.6.2.

6.3.2 Measurement immediately after immersion

If the liquid used in the test is volatile at ambient temperature, determination of the properties shall commence 2 to 3 min after removal of the specimens from the liquid.

NOTE — As a general rule, it is recommended not to wait before commencing the determination of the properties.

6.3.3 Measurement after immersion and drying

Dry the specimens in the ventilated oven, controlled at the specified temperature, for the specified time or, in the absence of any specification, at 50 ± 2 °C for 2 h ± 15 min. Allow the specimens to cool if necessary and recondition them in accordance with 6.3.1.

NOTE — In certain cases, the interested parties may agree that the plastics under test require no conditioning.

Redetermine the values of the selected physical properties in accordance with the relevant International Standards

6.3.4 Measurement only after immersion and drying

Immediately after immersion, remove the specimens, rinse and wipe them, then place the specimens in the drying oven and proceed in accordance with 6.3.3.

6.4 Calculation and expression of results

6.4.1 Calculate the values of the physical properties as specified in the relevant International Standards.

Calculate the average values of :

V_1, the values of the property for each specimen before immersion (or of the control specimen);

V_2, the values of the property for each specimen immediately after immersion;

V_3, the values of the property for each specimen after immersion, drying and reconditioning.

6.4.2 For measurable properties (i.e. those for which the measurement scale is proportional) calculate the final percentage value of this property with respect to the initial value[1] by the respective formulae :

$$(V_2/V_1) \times 100$$

or

$$(V_3/V_1) \times 100$$

These percentages may be greater than, equal to, or less than 100 %, the value 100 % signifying that the action of the liquid has not affected the property concerned.

6.4.3 If applicable, plot graphs of the results as a function test duration.

7 Test report

The test report shall include the following information :

a) a reference to this International Standard;

b) complete identification of the material or produ tested;

c) the type of specimens used, their method of prepar tion, their dimensions, surface condition, etc.;

d) the conditioning procedure used;

e) the test liquids used, test temperatures and duration and any other applicable conditions (illumination darkness, vapour, etc.);

f) the temperatures and duration of any applicable dryin procedure;

g) the methods of visual examination used;

h) the properties investigated and the methods of tes used;

j) the results obtained, determined in accordance with 4.7 5.3.2, 5.4.2, 5.5.2, 6.4, as applicable;

k) if prepared, graphs of the results as a function of time

m) if requested, the result of the examination of the tes liquid after the test;

n) any occurrence likely to have had an effect on the results.

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[1] This calculation has no significance for assessed properties (i.e. those for which the scale is arbitrary).

Annex A

Types of test liquids

A.1 Tables 2 and 3 provide details of laboratory chemicals and miscellaneous products which may be used as test liquids, after agreement between the interested parties. The preparation of certain of these liquids by dilution of concentrated products can be dangerous and should be undertaken only under the supervision of an experienced chemist.

A.2 The hazards associated with the handling of these products, together with the precautions to be taken, are indicated in the tables by the following key :

A : products that are corrosive in various degrees and which should never come into contact with the skin or clothing. Use safety pipettes only.

B : flammable products, not to be handled near a source of ignition.

C : products that give off irritant or toxic fumes and which should be handled only under an efficiently ventilated hood.

Table 2 — Laboratory chemicals

NOTE — All these products shall be of laboratory reagent quality.

Test liquid	Concentration[1)]		Precautions to be taken (see clauses A.1 and A.2)	Comments	Density at 20 °C[2)] kg/m³
	% (*m*/*m*)	kg/m³			
Acetic acid	99,5		A + C	Concentrated	1 050
Acetic acid	5	50		Add 50 ml of concentrated acetic acid to 950 ml water	
Acetone	100		B		785
Ammonium hydroxide solution	25	230	A + C	Expressed as ammonia (NH_3)	907
Ammonium hydroxide solution	10	96	A + C	Expressed as ammonia (NH_3)	958
Aniline	100		A + C		1 021
Chromic acid solution	40 (as CrO_3)	550	A + C	Add 3 ml of concentrated sulphuric acid per litre of solution	—
Citric acid solution	10	100			
Diethyl ether	100		B + C		719
Distilled water	100				
Ethanol		770	B	96 % (*V*/*V*) (71° O.P)	802
Ethanol	50	460		1 000 ml of 96 % (*V*/*V*) ethanol and 740 ml water	
Ethyl acetate	100		B + C		901
n-heptane	100		B		683
Hydrochloric acid	36		A + C	Concentrated	1 180
Hydrochloric acid	10	105	A + C	Add 250 ml of concentrated hydrochloric acid to 750 ml water	
Hydrofluoric acid[3)]	40	450	A + C		1 160
Hydrogen peroxide	30	330	A	Not diluted	
Hydrogen peroxide	3	31	A	10 volumes of 30 % (*V*/*V*) H_2O_2 and 90 volumes water	
Lactic acid	10	100			
Methanol	100		B + C		790
Nitric acid	70	—	A + C	Concentrated	1 420
Nitric acid	40	500	A	Add 500 ml of concentrated nitric acid to 540 ml water	1 250
Nitric acid	10	105	A	Add 105 ml of concentrated nitric acid to 900 ml water	1 050
Oleic acid	100				890
Phenol solution	5	50	A		
Sodium carbonate solution	20	216	A	Expressed as $Na_2CO_3.10H_2O$	1 080
Sodium carbonate solution	2	20	—		1 010
Sodium chloride solution	10	108	—		1 070
Sodium hydroxide solution	40	575	A		1 430
Sodium hydroxide solution	1	10	A		1 010
Sodium hypochlorite solution	10		A + C	9,5 % active chlorine	
Sulphuric acid	98		A	Concentrated	1 840
Sulphuric acid	75	1 250	A	Add 695 ml of concentrated sulphuric acid to 420 ml water	1 670
Sulphuric acid	30	366	A	Add 200 ml of concentrated sulphuric acid to 850 ml water	1 220
Sulphuric acid	3		A	Add 17 ml of concentrated sulphuric acid to 990 ml water	1 020
Toluene	100		B		871
2,2,4-Trimethylpentane (*iso*-octane)	100		B		698

1) The numerical values of concentrations in grams per litre and kilograms per cubic metre are the same.

2) The mass per unit volume in grams per millilitre is obtained by dividing the mass per unit volume in kilograms per cubic metre by 1 000.

3) If, during the various operations, hydrofluoric acid solution is splashed onto the skin, the latter must be treated immediately with a solution or a gel of calcium gluconate.

Table 3 — Miscellaneous products

NOTE — The quality, reference and/or the composition of the miscellaneous products in this table shall, if necessary, be subject to preliminary agreement between the interested parties.

Test liquid	Remarks	Precautions to be taken (see clauses A.1 and A.2)
Mineral oil	For example, reference oil No. 1, 2 or 3 of ISO 1817[1]	
Insulating oil	In accordance with IEC Publication 296	
Olive oil	Quality to be specified	
Cotton seed oil	Quality to be specified	
Solvent mixtures	For example, reference solvents A, B, C and D of ISO 1817[1]	B
Soap solution	1 % soap solution prepared from soap flakes	
Detergent	The quality and concentration of the product to be specified	
Essence of turpentine	As specified in ISO 412	B
Kerosene	Quality to be specified	B
Petrol (gasoline)	Quality to be specified	B

1) ISO 1817 deals with the effect of liquids on vulcanized elastomers.

Annex B

Note on the absorption of moisture by a specimen of a plastic in equilibrium with its conditioning atmosphere

B.1 The amount and rate of absorption of moisture by a specimen conditioned in a humid atmosphere vary considerably according to the nature of the plastic.

B.2 The conditioning procedures established in this International Standard (see 4.5) are, generally, satisfactory with the exception of :

a) materials that are known to reach equilibrium with their conditioning atmosphere only after a very long time (for example, certain polyamides);

b) new materials or those of unknown structure, for which no *a priori* forecast can be made either of their ability to absorb moisture, or of the time required to reach equilibrium.

B.3 For the materials mentioned in clause B.2, one of the following procedures may be agreed between the interested parties :

a) drying of the material at elevated temperature. This procedure has the disadvantage that certain properties, in particular mechanical ones, differ in the dried state from those obtained after conditioning in atmosphere 23/50;

b) conditioning of the specimens at 23 ± 2 °C and 50 ± 5 % relative humidity until equilibrium is reached. In this case a convenient criterion may be for the mass to be constant within 0,1 % for two determinations separated by an interval of e^2 weeks (e being the thickness, in millimetres, of the specimen). For certain polymers it is sufficient to plot the mass/time graph, with time intervals very much less than e^2 weeks; for practical purposes equilibrium is considered to be reached when the gradient of the graph, expressed as a percentage, is equivalent to 0,1 % over e^2 weeks.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 1817 :1985 Rubber, vulcanized—Determination of the effects of liquids	IS 3400 (Part 6) : 1983 Methods of test for vulcanized rubbers : Part 6 Resistance to liquids	Technically Equivalent
ISO 2818 : 1994 Plastics — Preparation of test specimens by machining	IS 13360 (Part 2/Sec 4) : 1993 Plastics — Methods of testing : Part 2 Sampling and preparation of test specimens, Section 4 Preparation of test specimens by machining	Not technically equivalent in all respects. However, this Indian Standard is being revised to align it with ISO standard
ISO 3126 : 1974 Plastics pipes — Measurement of dimensions	—	—
ISO 3205 : 1976 Preferred test temperatures	Nil	—
IEC Publication 296 : 1982 Specification for unused mineral inslulating oils for transformers and switchgears	IS 335 : 1993 New insulating oils	Technically Equivalent

In the case of ISO 3126, there is no identical/technically equivalent Indian Standard available. However, the dimensional requirement for the various plastics pipes like LDPE pipes, HDPE pipes, UPVC pipes, etc, are specified in the corresponding products specification itself.

In the case of ISO 3205 the technical committee responsible for the preparation of this standard has reviewed its contents and has decided that it is acceptable for use in conjunction with this standard.

For tropical countries like India, the standard temperature and the relative humidity shall be taken as 27 ± 2°C and 65 ± 5 percent respectively.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

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